SuperSpec: A Revolutionary New Spectrometer for Submillimeter Astronomy

Completed Technology Project (2015 - 2019)

Project Introduction

SuperSpec is a new spectrometer for submm astronomy. SuperSpec stands out from other submm spectrometers in that the detectors are coupled to a series of resonant filters on a single feedline instead of optics. SuperSpec uses kinetic inductance detectors (KIDs) to detect radiation in this filter bank. The natural multiplexibility, simplified manufacturing process, and small physical size of KIDs allow for the creation of a wide band 500 channel spectrometer that can be lithographically patterned on only a few square cm of silicon. This technology has the potential to transform the field of submm spectroscopy, allowing 100s to 1000s of spectrometers to be packed into a single 2D focal plane without the need for large cryogenic optical systems. The goal of our collaboration is to produce two R~600 science grade prototypes, one for the 1 mm (195-305 GHz) atmospheric window, and another covering the 850 Âµm and 650 Âµm (315-510 GHz) windows, and test these on a ground-based telescope (the Caltech Submillimeter Observatory or Submillimeter Telescope). The end result will be an increase in the Technology Readiness Level (TRL) from 4 to 5 through demonstration in a relevant environment. My personal involvement at the University of Colorado will be to lead the measuring of both the optical noise equivalent powers (NEPs) with our FTS and the dark NEPs with a cryogenic blackbody. In addition to this, I will also simulate and model the detectors and work to improve device designs. Finally, I will work to define the scaling requirements, for a future NASA mission, needed to meet the TRL 5 exit criteria. This would include defining requirements such as: how to decrease the NEP to the level of the background limited performance of a balloon-borne or cryogenically cooled telescope and how to move from our single device prototypes to a multi-object spectrometer.

Anticipated Benefits

This technology has the potential to transform the field of submm spectroscopy, allowing 100s to 1000s of spectrometers to be packed into a single 2D focal plane without the need for large cryogenic optical systems. The goal of our collaboration is to produce two R~600 science grade prototypes, one for the 1 mm (195-305 GHz) atmospheric window, and another covering the 850 \xe5µm and 650 \xe5µm (315-510 GHz) windows, and test these on a ground-based telescope (the Caltech Submillimeter Observatory or Submillimeter Telescope).

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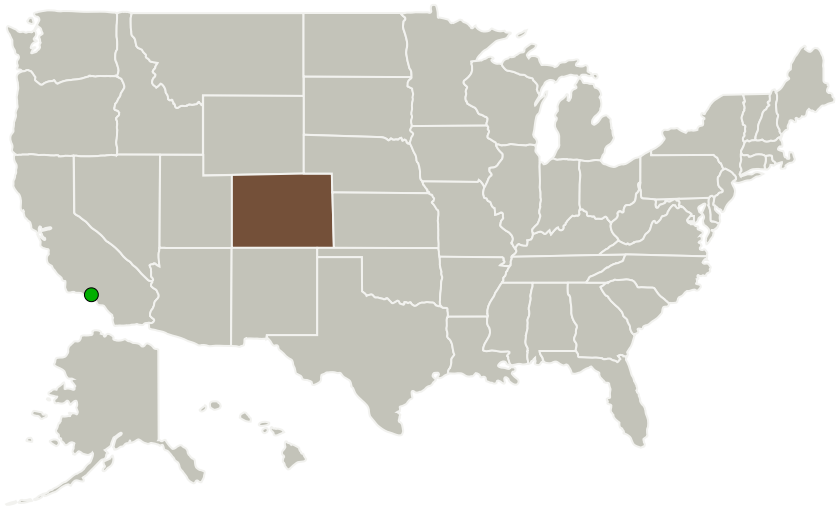
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
University of Colorado Boulder	Lead Organization	Academia	Boulder, Colorado
Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations
Colorado

Project Website:

https://www.nasa.gov/strg#.VQb6T0jJzyE

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

University of Colorado Boulder

Responsible Program:

Space Technology Research Grants

Project Management

Program Director:

Claudia M Meyer

Program Manager:

Hung D Nguyen

Principal Investigator:

Jason Glenn

Co-Investigator:

Jordan D Wheeler

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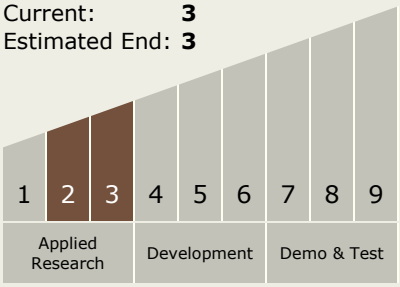
Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.1 Detectors and Focal Planes

Target Destinations

The Sun, Others Inside the Solar System, Outside the Solar System